AP Chemistry

Chapter 1 Supplemental Problems Key

1. Homogeneous, Heterogeneous, Heterogeneous, Homogeneous

2. a. orange = physical

   b. turns to rust = chemical

   c. explode = chemical

   d. density = physical

   e. melts = physical

   f. green = physical

3. Physical, Chemical, Chemical, Chemical, Physical

4. One could check for an odor, check the boiling or freezing point, or determine the density. If the density is approximately $1 g/cm^3$ at room temperature, the liquid could be water. If it boils at about 100°C and freezes about 0°C, that would be consistent with water. To check for the presence of salt, boil the liquid away. If a substance remains, it could be a salt, but further testing would be required.

5. a. Qualitative = blue-green, solid

   Quantitative = $2.65 g/cm^3$ and 2.5g

   b. Extensive = 2.5g

   Intensive = blue-green, solid, and $2.65 g/cm^3$

   c. $V = 2.5g / 2.65g/cm^3 = .94cm^3$

6. $D = m/V$

   $= 23.5g / (52.2mL - 47.5mL)$

   $= 23.5g / 4.7mL =$ **5.0g/mL**

7. $°F = 9/5\ (37°C) + 32 = 98.6 =$ **$99°F$**

$°C = 5/9\ (98.2 - 32) =$ **$36.8°C$**

8. 4, 2, 5, 3, 4, 4

9. a. 37.8 m

b. 2.4 cm

c. 73.0 mm x 1.340 mm x (25.31 mm – 1.6 mm)

{ 23.7 mm}

= 2318.234 = **$2.32 \times 10^3\ mm^3$**

d. $\frac{2.023\ g - 1.8 \times 10^{-3}\ g}{1.05 \times 10^4\ mL} = 2.021\ g / 1.05 \times 10^4\ mL =$ **$1.92 \times 10^{-4}\ g/mL$**

10. The result would be 12.108 g – 12.024 g = **.084 g** You can see because of the rules of addition/subtraction, even though each measurement had 5 significant digits, the final answer only contains **2 significant digits.**

11. (0.50 mL)(1.0 g/mL)(.10)(1,000 mg/1g) = **50. mg**

12. (1.50 carat)(0.200 g/carat)(1 cm^3/3.513 g) = .085397... = **$8.54 \times 10^{-2}\ cm^3$**

13. 5.79 mg (1 g / 1,000 mg) = 5.79×10^{-3} g (1 cm^3 / 19.3 g)
= $3.00 \times 10^{-4}\ cm^3 / 44.6\ cm^2$ = **6.73×10^{-6} cm**

14. a. 100. lb (.4536) = 45.36 kg (1,000 g/1 kg) = $4.536\text{x}10^4$ g
b. 15. Gal (3.7854) = 56.781 L (1,000 L/ 1 L) = $5.6781\text{x}10^4$ g
c. 3.0 L (1,000 mL/ 1 L) = $3.0\text{x}10^3$ mL (13.6 g/ 1 mL) = $4.080\text{x}10^4$ g

Water would be the heaviest.

15. 10.8mL water displaced = 10.8g water displaced = 10.8g of wooden block

V = (1.0 in)(1.0 in)(1.0 in) = 1.0 in^3 (2.54 cm / 1 in)3 = 16.39 cm^3 (2 sig figs)

D = m/V = 10.8 g / 16.39 cm^3 = .659 g/cm^3 = **.66 g/cm^3**

16. 125 cm^3 powder (2.2 g/1 cm^3) = 275 g powder = 275 g aerogel (1 cm^3 / .015 g) = **$1.8\text{x}10^4$ cm^3** (= volume of aerogel)

17. Brass: V = $(2.0\text{ cm})^3$ = 8.0 cm^3 Brass sinks so it displaces 8.0 cm^3 of water.

Cork: V = (5.0 cm)(4.0 cm)(2.0 cm) = 40. cm^3 (.22 g/ 1 cm^3) = 8.8 g Cork

8.8 g water (1 cm^3/ 1 g) = 8.8 cm^3 water

The cork displaces more water than the brass

18. (7682 L)(1.77 lb/L) = 13,597.14 lbs (Not kg as they assumed)

(.803 kg/L)(7682 L) = 6168.646 kg left

22,300 kg – 6168.646 kg = **16131.354kg ($1.61\text{x}10^4$ kg) or 20,089 L ($2.01\text{x}10^4$ L) needed.**

AP Chemistry – Chapter 2
Supplemental Class Problems

Name: Key Date: ______________ Period: ______

1. It is common in chemistry to assume that the mass of a cation is the same as that of its parent atom.
   a) Using the following data: p = 1.0073amu, n = 1.0087amu and $e = 5.486 \times 10^{-4}$amu, determine the number of significant figures that must be reported before the difference in mass of ${}^{1}_{1}H$ and ${}^{1}_{1}H^{+}$ is significant.

   ${}_{1}H = 1.0073 + .0005486 = 1.00785$ ${}_{1}H^{+} = 1.0073$ [5 sig figs]

   b) What percentage of the mass of an ${}^{1}_{1}H$ atom does the electron represent?

   $5.486 \times 10^{-4} / 1.00785 = .000544 = [0.0544\%]$

2. The diameter of a U.S. penny is 19mm. The diameter of a copper atom, by comparison, is only 2.6Å. How many copper atoms could be arranged side by side in a straight line across the diameter of a penny?

   $19\,mm \,/\, 2.6 \times 10^{-7}\,\frac{mm}{atom} = [7.3 \times 10^{7}\,atoms]$

3. Using the mass of the proton and assuming its diameter is 1.0×10^{-15}m, calculate the density of a proton in g/cm³.

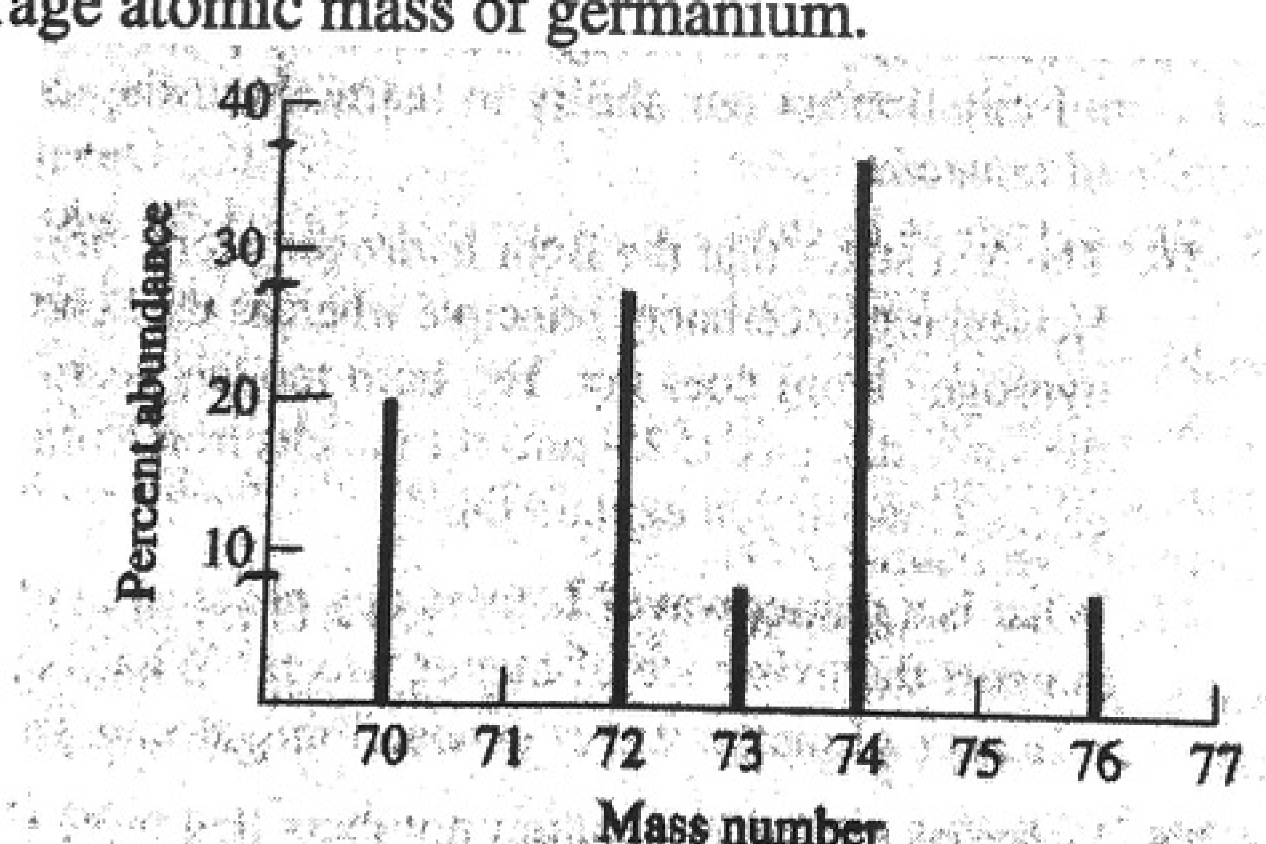
   $m_p = 1.672622 \times 10^{-24}g$ $V = \frac{4}{3}\pi r^3 = \frac{4}{3}\pi(\frac{D}{2})^3$

   $\rho = \frac{m}{V} = \frac{1.672622 \times 10^{-24}g}{5.24 \times 10^{-40}} = [3.2 \times 10^{15}\,g/cm^3]$ $= \frac{4}{3}\pi\left(\frac{1.0 \times 10^{-13}cm}{2}\right)^3 = 5.24 \times 10^{-40}\,cm^3$

4. The mass-to-charge ratio of the positron (a product of the radioactive decay of certain isotopes) is 5.6×10^{-12} kg/C. The charge on a positron is the same as that on a proton. Calculate the mass of a positron. Does any other fundamental particle have this same mass? Explain.

   $Q_p = {}^{+}1.602 \times 10^{-19}C$ $5.6 \times 10^{-12}\,kg/C\,(1.602 \times 10^{-19}C)$
   $\cong 8.97 \times 10^{-31}kg$ [$9.0 \times 10^{-31}kg$ Same mass as electron but opposite charge]

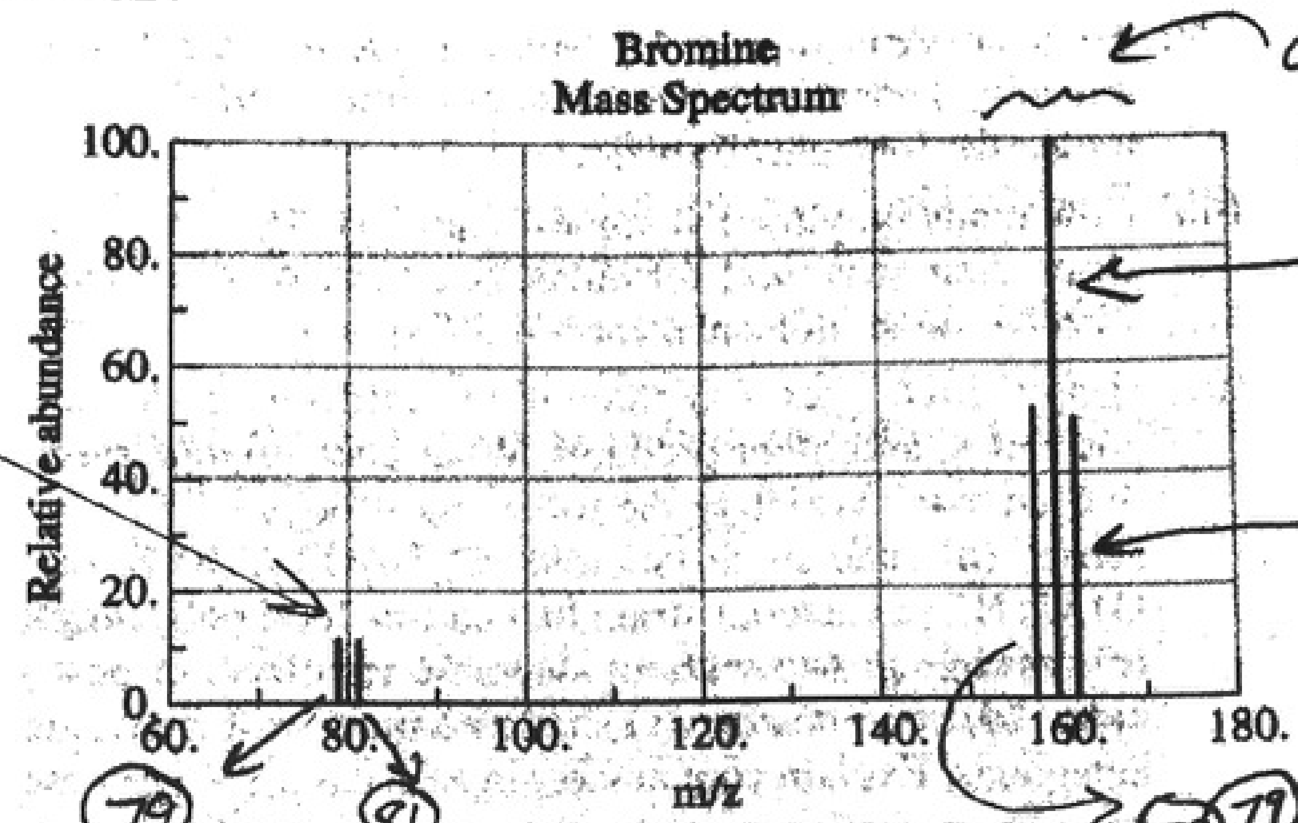
5. The atomic masses of the five naturally occurring isotopes of germanium are germanium-70, 69.9243u; germanium-72, 71.9217u; germanium-73, 72.9234u; germanium-74, 73.9219u; germainium-76, 75.9214u. Use these values and data from the accompanying bar graph mass spectrum of germanium to determine a weighted average atomic mass of germanium.



8 8 20 27 37

$69.9243(.20) + 71.9217(.27) + 72.9234(.08) + 73.9219(.37) + 75.9214(.08)$
$= [72.6624u]$

6. In mass spectrometry, molecules are ionized, and some of the ionized molecules are fragmented. Masses of the molecular ions and ionized fragments are found using magnetic and/or electric fields of known strength, and the relative numbers of fragments are plotted as a function of their mass-to-charge ratios, m/z. Because the ions typically carry a charge of 1+, for the majority of fragments, the m/z ratios also represent mass numbers. The mass spectrum of elemental bromine (Br_2) is shown below. Explain what species the peaks at 79, 81, 158, 160 and 162 represent. Why is the peak at 160 about twice that height of the ones at 158 and 162?



7. Natural chlorine, which has an atomic mass of 35.4527u, consists of chlorine-35 and chlorine-37 isotopes. Given that the mass of chlorine-35 is 34.96885u, what is the average atomic mass (in u), of a chlorine sample prepared by mixing equal numbers of chlorine atoms from a sample of natural chlorine and a sample of pure chlorine-35?

Natural Chlorine = 35.4527u Chlorine-35 = 34.96885u

average = $\frac{35.4527+34.96885}{2}$ = **35.2108 u**

8. A hypothetical element X is found to have an atomic mass of 37.45u. Element X has only two isotopes, X-37 and X-38. The X-37 isotope has a fractional abundance of 0.7721 and isotopic mass of 37.24. What is the isotopic mass of the other isotope?

X = 37.45 = (%)(mass of X-37) + (%)(mass of X-38)
= (.7721)(37.24) + (1-.7721)(x)
37.45 = (.7721)(37.24) + (.2279)(x) 8.697 = (.2279)(x) x = X-38 = **38.16u**

9. A monoatomic ion has a charge of +3. The nucleus of the ion has a mass number of 27. The number of neutrons in the nucleus is equal to the number of electrons in a S^{2+} ion. Identify the element and indicate the number of protons, neutrons, and electrons. S^{2+} = Sulfur 2+

Neutral Sulfur: 16 electrons Charged Sulfur = 14 electrons 14 = # of X^{3+} neutrons

mass of X^{3+} = y + 14 = 27 # protons = 13 **Element = Aluminum (Al) 13 p⁺, 10e⁻, 14 n°**

10. While traveling to a distant universe, you discover the hypothetical element "X". You obtain a representative sample of the element and discover that it is made up of two isotopes, X-23 and X-25. To help your science team calculate the atomic mass of the substance, you send the following drawing of your sample with your report.

In the report, you also inform the science team that the light atoms are X-23, which have an isotopic mass of 23.02u, and the dark atoms are X-25, which have an isotopic mass of 25.147u. What is the atomic mass of element X?

Fractional Abundance of X-23 = $\frac{5}{20}$ = .25
Fractional Abundance of X-25 = $\frac{15}{20}$ = .75
X = (.25)(23.02) + (.75)(25.147) = **24.62u**